It is, however, interesting to note that the remarkably well defined right-handed or eastward shifting of many radial streams that flow down the gentle slope of the great alluvial fan, known as the plateau of Lannemezan, at the northern base of the Pyrenees—beautifully shown on the 1:80,000 map of France, sheets 216, 217, 227, 228, 229, 239, 240, and 241—has been explained by Marchand and Fabre[2] not as a consequence of the earth's rotation but as a result of stronger action of rain driven by westerly winds; so that here it is the valley sides facing against the wind that are the steeper, while on Long Island the steeper valley sides face with the winds. It is difficult to understand just how either explanation works, but in any case the relation of the steep valley sides and the prevailing winds is unlike in the two examples.

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CAMBRIDGE, MASS.,
APRIL 2, 1922

POSSIBLE CAUSE OF THE RED COLOR OF POTASH SALTS

THE red color of certain potash and ordinary salt deposits has been observed in many parts of the world, for example, in the Indian, German, Alsatian and Spanish potash deposits, in Nova Scotia, west Texas and doubtless in other places that the writer has not heard of. The same, though a less intense coloration has been observed by the writer in the surface salt and strong brine standing in the trenches and in pools along the margin of the salt ponds where solar salt is made along the shore of San Francisco Bay, California. It has been noted at Searles Lake in the same state. I am told that the same red color exists also in the solar salt ponds on Turks Island. It is undoubtedly of common occurrence in many places where solar evaporation results in producing salt, either naturally or artificially.

The red color associated with certain potash minerals is so common that it has come almost to be regarded as a means of identifying certain of them, for example, the mineral carnallite in the German deposits. There is however, as chemists well know, nothing inherent in the composition of carnallite ($KCl.MgCl_2.6H_2O$) to cause this red tint and indeed the normal color of the pure double salt should be the same as that of ordinary white rock salt.

There has been a great diversity of opinion as to the origin of the red color in solar salt and bitterns where solar evaporation is in progress. That it is not necessarily due to the presence of iron appears evident from the observations of George Lunge, the expert on sulphuric acid manufacture. Lunge[1] states that:

> The red color exhibited by many alkaline salt lakes, which is often also apparent in the salt deposits, is ascribed by Payen[2] to the presence of small crustaceans, *Artemia Salina* Leach (*Cancer salinus* Linné), which appear in large masses when the water has attained a density of 1.16, and which are of a gray or greenish color; on further concentration to a specific gravity of 1.21, they die and form a red froth at the surface. . . . I, for my part, must decline to accept the assumption that the red color is regularly caused by the presence of *Artemia* or other animal organisms, if it is ever due to that cause; for the samples of red water which I had myself taken from the lakes of the Wade Atrun have preserved that color during the many years I have kept those samples. The red filtrate shows nothing under the miscroscope; the color is at once discharged by adding nitric acid or hypochloride and hydrochloric acid and is evidently caused by organic substances present in solution. There is no iron present.

Recent studies made in the U. S. Bureau of Fisheries, Department of Commerce, connected with the reddening of salt fish are of interest and importance in this connection. They are also of economic value in view of the considerable annual losses to the fish industry caused by salt fish developing a red color when stored under moist conditions. The Bureau investigations, which were conducted by W. W. Browne[3],

[1] Lunge, Geo., *Sulphuric Acid and Alkali*, Vol. 2, pt. 1, p. 58, 1909.

[2] Payen, Anselme, *Annales chim. et phys.*, 2d ser., Vol. 65, p. 156, 1837.

[3] Bureau of Fisheries, Document 896, 1920, pp. 27-28.

[2] Les érosions torrentielles et subaériennes sur les plateaux des Hautes Pyrénées. *C. R. Congr. Soc. savantes*, 1900.

indicate that the red color is due to two microorganisms, which probably originated in the sea salt used in curing the fish. The color varies from pale pink to deep crimson, the former the result of the growth of a spirochete, and the latter produced by a bacillus form.

These microorganisms grow in completely saturated brine on salt fish and on salt piles, but no growth appears in media containing less than 15 per cent. of salt by weight. The most favorable temperature for the growth of both organisms is between 50° and 60° C. indicating that the salt lagoons of the tropics are probably sources of infection. Sunlight is not germicidal, which also points to their tropical origin where pigmentation is required against bright sunlight. Ordinary bacteria are killed by ten minutes exposure to the bright sunshine. Salt acts as a preservative preventing the growth of most organisms, but here is an instance of just the opposite effect.

In summary, the results of recent investigation indicate that the cause of the red color in solar salt and brine is due to organisms as indicated above and that their source is salt produced by solar evaporation. Both European and American sea salt is infected, but mined salt is free from their presence.

The studies made by the Bureau of Fisheries and by others before it (See Bibliography published by Bureau of Fisheries) have suggested to the writer that possibly causes allied to those now producing red coloration in solar salts may have been active as long ago as the Permian. Whatever may be the main cause of the reddening of the Permian potash salts, the question naturally arises, is the reddening in the potash salts of the German Permian, the Alsatian Oligocene and the Spanish Tertiary deposits due to the same or similar agencies that are causing reddening in the solar salt of the present time. It is probable that both types of salts have been formed under essentially similar conditions, that is, salt pan conditions. If this last statement be admitted, then it points to the growth of bacteria, at least intermittently, from the Permian down to the present.

This is presented to induce further study along this line and to elicit discussion and opinions. Such studies may also throw some light on temperatures during Permian and later geologic time.

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POPULAR SCIENCE

TO THE EDITOR OF SCIENCE: I am sorry to see that Dr. E. Dorsey confirms[1] the opinion expressed by Dr. Brooks[2] and myself[3] that science is relatively losing ground in popular interest and esteem. I fear he is right also in saying that this is in part the fault of scientists. For the prevalent indifference and even hostility of the public to the higher teachings of science may be matched by the indifference and even hostility of certain scientific men to the "vulgarisation of science."

It is quite true, as Dr. Dorsey points out, that isolated facts, however numerous and authentic, do not constitute science. I have kept that point in mind in all our Science Service work. For instance I said in a recent magazine article:[4]

> We can get from the reading of science not only new things to think about, but, what is more important, new ways of thinking about things.

But I hope that Dr. Dorsey will not discourage those of us who are trying to get a larger amount of "mere information" in the newspapers. A few more facts are really needed to season the mass of fiction there. We may also hope to get over some idea of the relations between facts and how the scientist finds his facts and what he gets out of them. But we can not expect that the newspaper reader will acquire the habit of persistent experimentation, constant criticism, rigorous reasoning, projection of hypotheses, balancing of theories and suspension of judgment characteristic of the scientific mind. If the layman

[1] SCIENCE, 55: 374, 1922.

[2] *Journal Washington Academy of Sciences*, 12: 73, 1922.

[3] SCIENCE, 55: 241, 1922.

[4] "Science from the Side Lines," in *The Century*, January, 1922.